

ISOBUS WIRELESS NETWORKING OF AGRICULTURAL MACHINES IN A COLLABORATIVE AGRICULTURAL PROCESS

RELATED APPLICATION

[0001] Under provisions of 35 U.S.C. §119(e), Applicant claims the benefit of U.S. Provisional Application No. 62/140,210, entitled and filed Mar. 30, 2015.

FIELD

[0002] The present invention relates to systems and methods for communicating and controlling the operation of agricultural machinery, particularly multiple otherwise independent agricultural machines engaged in various aspects of an overall collaborative agricultural process.

BACKGROUND

[0003] When operating multiple otherwise independent agricultural machines engaged in various aspects of an overall collaborative agricultural process, it is often desirable to synchronize their activities. Achieving synchronization is dependent on understanding the state and behavior of the various machines. In particular, aggregating data from some machines for use by other machines requires synchronization in order to understand which machines should be supported and which should be denied at any particular point in the process. Attempts to achieve synchronization depend on communication between and control by human operators, but this often results in many points of failure which prevent maximizing synchronization, which reduces the efficiency of the overall process.

[0004] This background discussion is intended to provide information related to the present invention which is not necessarily prior art.

SUMMARY

[0005] Embodiments of the present invention solve the above-described and other problems and limitations by providing for substantially automating the communication between and control of multiple otherwise independent agricultural machines engaged in various aspects of an overall collaborative agricultural process, and thereby eliminating many potential points of synchronization failure. This improves the efficiency of the overall process by reducing cost and improving productivity through increased speed, accuracy, and consistency.

[0006] In one embodiment, a system for performing the agricultural process may comprise the plurality of agricultural machines, wherein each machine is engaged in performing an aspect of the process, and each machine is in electronic communication with every other machine in the system using a standardized communication and control protocol such that the plurality of machines form a networked group. The performance of each machine is substantially synchronized with the performances of the other machines in the networked group based on information electronically communicated by each machine.

[0007] In various implementations of this embodiment, the system may further include any one or more of the following features. The plurality of machines may include a first machine having a hardwired network connection, a second machine having both a hardwired network connec-

tion to at least one first machine and a wireless network connection to at least one other second machine, and a third machine having a wireless network connection to at least one second machine. The first machine may be an unmanned agricultural implement, and the second machine may be a manned agricultural tractor connected via the hardwired network connection to the first machine. The substantial synchronization of the performances of machines may be achieved, at least in part, substantially automatically. The information may include geographic position, relative position, wayline position, speed, load level, and fill level.

[0008] The system may further include one or more sensors engaged in performing a sensor aspect of the agricultural process, with each sensor being in electronic communication with every other sensor and machine in the system using the standardized communication and control protocol such that the sensors are also part of the networked group. The system may further include a station engaged in performing a station aspect of the agricultural process, with the station being in electronic communication with the sensors and the machines in the system using the standardized communication and control protocol such that the station is also part of the networked group.

[0009] The standardized communication and control protocol may be an ISO 11783 Compliant Implement Control standard. An ISO 11783 Virtual Terminal standard may be used to facilitate providing output to and receiving input from operators of the second and third machines. The second machine may have a computer area network bus, and an ISO 11783 Task Controller standard may be used to remotely inject Object Pools for the virtual terminal into this bus. An ISO 25119 Machine Directive standard may be used to facilitate communication between and control of the machines. The second machine may include a gateway device configured to extend the networked group to additional machines provided with wireless network connections.

[0010] Additionally, each of these embodiments and implementations may be alternatively characterized as methods based on their functionalities. In one embodiment, a method broadly comprises the steps of placing each agricultural machine in electronic communication with every other machine involved in the agricultural process using the standardized communication and control protocol such that the plurality of machines form the networked group, and then synchronizing the performance of each machine with the performances of the other machines in the networked group based on information electronically communicated by each machine.

[0011] In various implementations of this embodiment, the method may further include any one or more of the following steps. The method may further including the steps of incorporating a first set of the machines into the networked group, and then dynamically incorporating additional machines into the networked group. The method may further include the step of achieving a longer range for the networked group using a mesh networking technique wherein an intermediate gateway device associated with an intermediate machine is used to route communication from a remote gateway device associated with a remote machine which is otherwise beyond a communication range of the networked group.

[0012] This summary is not intended to identify essential features of the present invention, and is not intended to be